

Unmasking the Confusion of Respiratory Protection to Prevent Influenza-Like Illness in Crowded Community Settings

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(See the article by Aiello et al, on pages 491–8.)

The 2009 novel influenza A(H1N1) (hereafter “nH1N1”) pandemic has sparked renewed interest in, and controversy regarding, the use of respiratory protection to reduce influenza transmission. Use of masks to prevent influenza generally applies to 2 populations: health care workers (HCWs) providing care for patients with proven or suspected influenza to both protect the HCW and prevent nosocomial transmission to high-risk patients; and persons in certain community settings, such as in households of individuals at high risk for influenza complications.

In this issue of the *Journal*, Aiello et al [1] report on the effectiveness of using a face mask combined with hand hygiene for preventing transmission of influenza-like illness (ILI) in a crowded community setting: college residence halls. The authors should be commended for undertaking this logistically challenging, yet important, endeavor as they have conducted

a well-designed, cluster randomized study. College students living in residence halls were randomized to a face mask with hand hygiene (FMHH) group, face mask only (FM) group, or control group. Importantly, all participants, including those in the control group, received information on hand hygiene. All reviewed a basic hand hygiene educational video without specific information on appropriate technique. Participants in both intervention groups (the FMHH and FM groups) viewed additional video on how to properly perform hand hygiene, but only those in the FMHH group received written instructions on proper hand sanitizer use along with a supply of hand sanitizer. Intervention group participants were instructed to wear face masks as frequently as possible when in the residence hall, in addition to encouraging the use of face masks when outside the halls. Of note, the 6-week intervention period began with the first laboratory-confirmed case of influenza among the campus population. Prior studies of community use of respiratory protection only initiated face mask use once an index case of influenza [2] or influenza-like illness [3] was identified in the home. Because close contacts in this setting may have already been incubating infection before the initiation of respiratory protection, demonstration of a protective

effect of face mask use may be more difficult.

As presented by Aiello et al [1], FMHH—when initiated after the first confirmed case of influenza in a *community*—provided protection against ILI when implemented in crowded residential settings. Participation in both the FMHH and FM-only groups resulted in significantly fewer episodes of ILI than the control group, during weeks 4–5 in the FM group and weeks 4–6 in the FMHH group. The lack of protection against ILI earlier in the study period is of interest. As nicely described by the authors, several possible explanations exist, including the continued recruitment of participants into the second week of the study, substantially higher rates of mask adherence during weeks 3–6, and a late peak in laboratory-confirmed influenza in the community. Face mask adherence was measured by conducting observations during predefined times when and where student activity was likely to be greatest (ie, meal times, common areas).

The importance of hand hygiene, however, cannot be overemphasized. Because the FMHH group was the only group with a significant reduction in ILI over the entire intervention period when adjusted for covariates, one must question whether the effect noted was due to hand hygiene ed-

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ucation and provision of hand sanitizer to the FMHH group. However, there was a clear trend for protection from ILI in the FM group, even with moderate adherence to mask use (<4 h/day). The study, however, was not powered to detect small differences that may be demonstrated by the incremental use of face masks to hand hygiene, particularly during a relatively mild 2006–2007 influenza season.

The reduction in influenza transmission related to face mask use may be due to protection of the wearer from acquisition of the virus, the physical obstruction of viral shedding from an ill individual, or both. Use of either a face mask or respirator can filter influenza virus to undetectable levels when measured by real-time polymerase chain reaction (PCR) at a distance of 20 cm from an infected patient [4], which suggests that decreasing viral shedding from an infected person may have an important role in the observed effect. The effect of the mask, however, may also be to reduce direct inoculation of virus via hand-to-mouth and nose. When used within 36 h of the diagnosis of influenza for an index household contact, FMHH resulted in a significant reduction in laboratory-confirmed influenza among household contacts [2], which suggests that FMHH provides protection from acquiring influenza.

The choice of respiratory protective equipment thus becomes another issue. Does a face mask afford the same protection as an N95 respirator? The effectiveness of the different types of respiratory protection for influenza has been the subject of substantial debate. It is generally accepted that influenza spreads primarily via large droplets transmitted when an infected person coughs or sneezes. This is substantiated by previously reported epidemiologic investigations of influenza outbreaks, as well as the lack of reports of explosive influenza outbreaks in settings in which a face mask is used as the primary method of respiratory protection (ie, health care settings) [5, 6].

Nonetheless, concern remains regarding airborne transmission of influenza, a mechanism of spread similar to that of tuberculosis, where smaller particles of infectious material are carried over long distances via air currents and one in which a face mask should not provide protection. However, most studies offered as evidence for airborne transmission of influenza were extrapolations from studies of other respiratory pathogens, involved experimental aerosols that arguably differ from infectious particles generated during natural infection, determined the presence of influenza-positive particles via PCR, which does not necessarily denote infectivity, or were observational studies in which transmission via larger droplet spread at close distances cannot be excluded [7–9].

Fortunately, several well-designed *in vivo* studies have now been published that conclude there is no significant advantage of one mask type over another for respiratory protection against influenza or ILI. Loeb et al [10] conducted a noninferiority randomized, controlled study of mask use among nurses in Ontario, Canada, which demonstrated that the attack rate of laboratory-confirmed influenza was not different between those who wore face masks and those who wore N95 respirators as respiratory protection (23.6% vs 22.9%, respectively). Although unable to demonstrate a protective benefit of mask use in households, MacIntyre et al [3] did note that adherence to mask use (face mask or N95 respirator) was associated with a reduction in ILI (hazard ratio, 0.26; 95% CI, 0.09–0.77).

Taken together with the Aiello et al [1] study, these data suggest that influenza transmission and ILI can be effectively interrupted with the use of a face mask and hand hygiene in settings of close contact. In addition, these data could inform the ongoing debate concerning respiratory protection for HCWs. Although the majority of data supporting prevention of influenza transmission with face masks has

been derived from community sites, interactions between HCWs and patients are generally of a magnitude similar to what would be encountered in domestic settings. One could even argue that the household setting poses greater risk of transmission as a result of continued, prolonged exposure, whereas most HCW encounters with patients are brief, albeit possibly more frequent.

Aiello et al [1] have conducted a well-designed cluster randomized study demonstrating that use of a face mask combined with hand hygiene in a crowded community setting is helpful in preventing ILI. Although it would be difficult to extrapolate these data to the general public in noncrowded conditions (ie, nonresidential settings), these data can inform policy makers on the recommendations for mask use in community settings and perhaps other settings (eg, health care institutions). Currently, for the community setting, the Centers for Disease Control and Prevention recommends the use of a face mask or N95 respirator only for persons at increased risk for influenza where nH1N1 is circulating in the community. An interesting footnote is “[t]he use of face masks may be considered as an alternative to respirators, although they are not as effective as respirators in preventing inhalation of small particles, which is one potential route of influenza transmission” [11], leaving one to infer that N95 respirators provide superior protection against ILI. The requirement for proper fit, the substantial additional cost, and the need to ensure adequate supplies for other infections known to require respirators for protection (eg, tuberculosis or measles), coupled with the data presented by Aiello et al [1], support a recommendation for face mask use, and not N95 respirators, to prevent transmission of influenza and ILI.

Informing the public on the proper use of face masks will not be easy. Determining exactly when to start and, perhaps more challenging, when to stop using a face

mask, will need to be defined. It is also important to remember that mask use is but one tool for preventing the spread of influenza. Hand hygiene remains critically important, as does annual influenza vaccination. Astoundingly and unfortunately, many doses of influenza vaccine are wasted each year as a result of lack of use, and vaccination rates in target groups, such as HCWs, have languished at levels well below desired targets. Staying home when ill and covering coughs and sneezes are also ways in which we can be good citizens by not exposing others to illness. Thanks to the findings of Aiello et al [1], recommendation of the use of face masks, combined with a continued emphasis on hand hygiene for preventing ILI in crowded community settings, is reasonable and based on scientific data, in contrast with recommendations that advocate for the use of an N95 respirator to prevent influenza transmission in various settings.

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